Thermal printing mechanism

MT002

User's Manual

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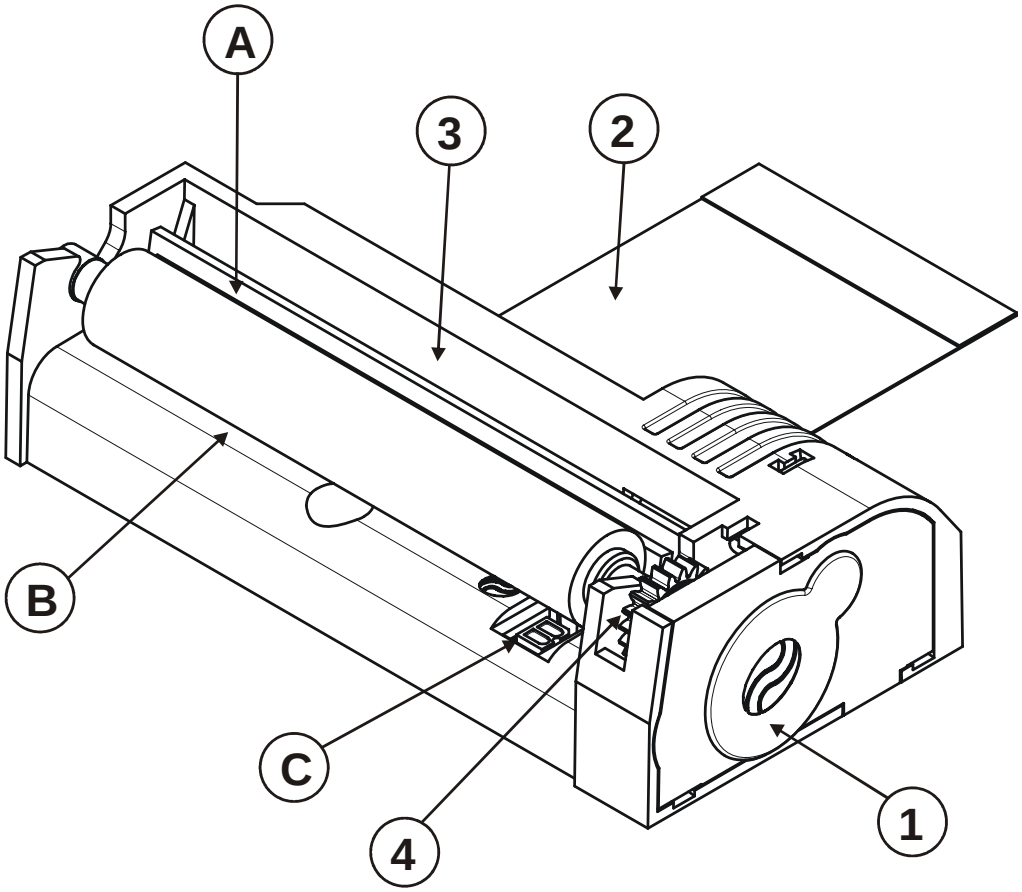
Printing mechanism models

A. MT002 Front exterior view

1- Motor
2- Print Head cable
3- Print Head
4- Knob paper feed
A- Paper input
B- Paper outfeed
C- Paper end sensor



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CONVENTIONS USED IN THE MANUAL

N.B.
Gives important information or suggestions relative to the use of the printer.

WARNING
The information marked with this symbol must be carefully heeded to safeguard against damaging the printer.

DANGER
The information marked with this symbol must be carefully heeded to safeguard against injury to the operator.

GENERAL SPECIFICATIONS

(Tab. 1)

Item		Specification		
Printing method		Thermal line dot method		
Effective printing width		48 mm ± 0,2 mm		
Head configuration (dots/line)		384		
Dot Pitch		0,125 mm		
Printing Speed		up to 90 mm/sec		
Paper width (mm)		58 mm + 0 / -1 mm		
Paper roll maximum diameter		60 mm		
Paper feed method		Friction feed, 1 dot line/2 pulses, bipolar		
Head temperature sensor		Thermistor		
Paper detection		Photo interrupter reflessive		
Maximum number of dots activated at a time		100		
Dot resistance (Rav)		176 Ω ± 4%		
Number of strobes		2		
Header energy	**5 °C**	0,16 mJ/dot (0,68 ms) V_H = 7.2V		
	25 °C	0,13 mJ/dot (0,55 ms) V_H = 7.2V		
	45 °C	0,11 mJ/dot (0,47 ms) V_H = 7.2V		
Driver saturated resistance (Ric)		9 Ω		
External dimensions (W x D x H)		67,3 x 17,4 x 33		
Weight		36 gr.		
Operation Voltage Thermal head		5 V ± 5%		
Current consumption		Medium 2,5 A	Max 4 A	Peak 3 A
Life/Reability		50 Km 1 x 10^8 pulses		
Recommended paper weight		55 g/m^2		
Recommanded paper		OJI KF-50HDA or equivalent		
Noise		Max 51dbA		

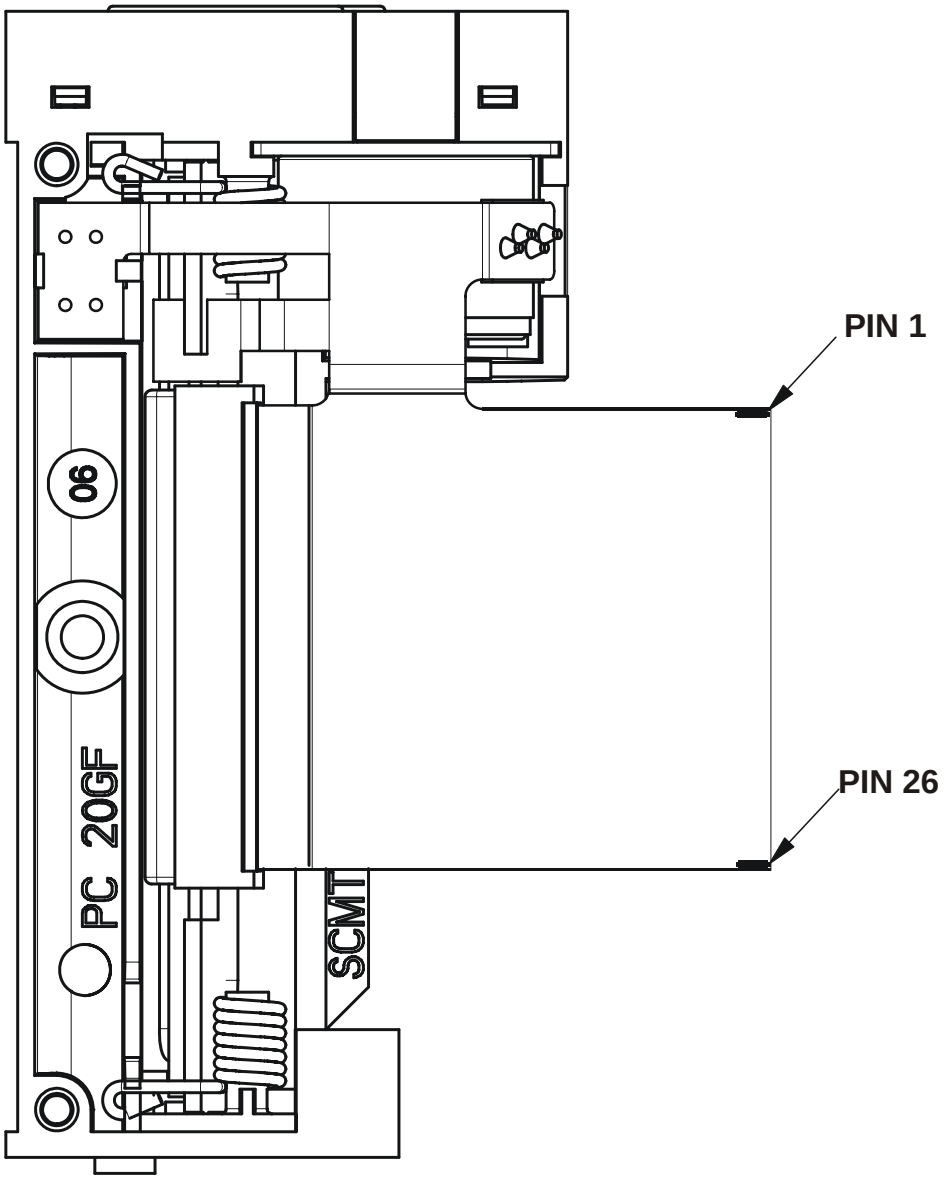
Maximum ratings at 25°C **(Tab. 2)**

Item	Specification
Head voltage	V_H = 8,5 V
Supply voltage	V_{DD} = 7 V
Substrate Temperature	65 °C
Environment operating temperature range	-10 ÷ 50°C
Operating humidity	10 ÷ 90 % RH no condensation
Environment storage temperature (except paper)	-20 ÷ 70 °C

MAIN FEATURES

- Paper width : 58 mm + 0 / -1 mm.
- Resolutions 8dot/mm - 203dpi
- Autoloading capability.
- Printing speed up to 90 mm/sec.
- Sensors: Paper end sensor, temperature sensor thermistor 30K.
- Life 50 Km Printed paper.
- Compact Layout.

BOTTOM VIEW



(Fig.1.1)

1.1 CONNECTIONS TERMINALS

The mechanism has one interface connector (see fig. 1.1), that includes the thermal head signal, motor control and paper sensor control. The connector's pin assignments is as follows (see Tab. 1.1):

Connector type : ZIF connector for flexible printed circuit 26 pin (pitch 1 mm)

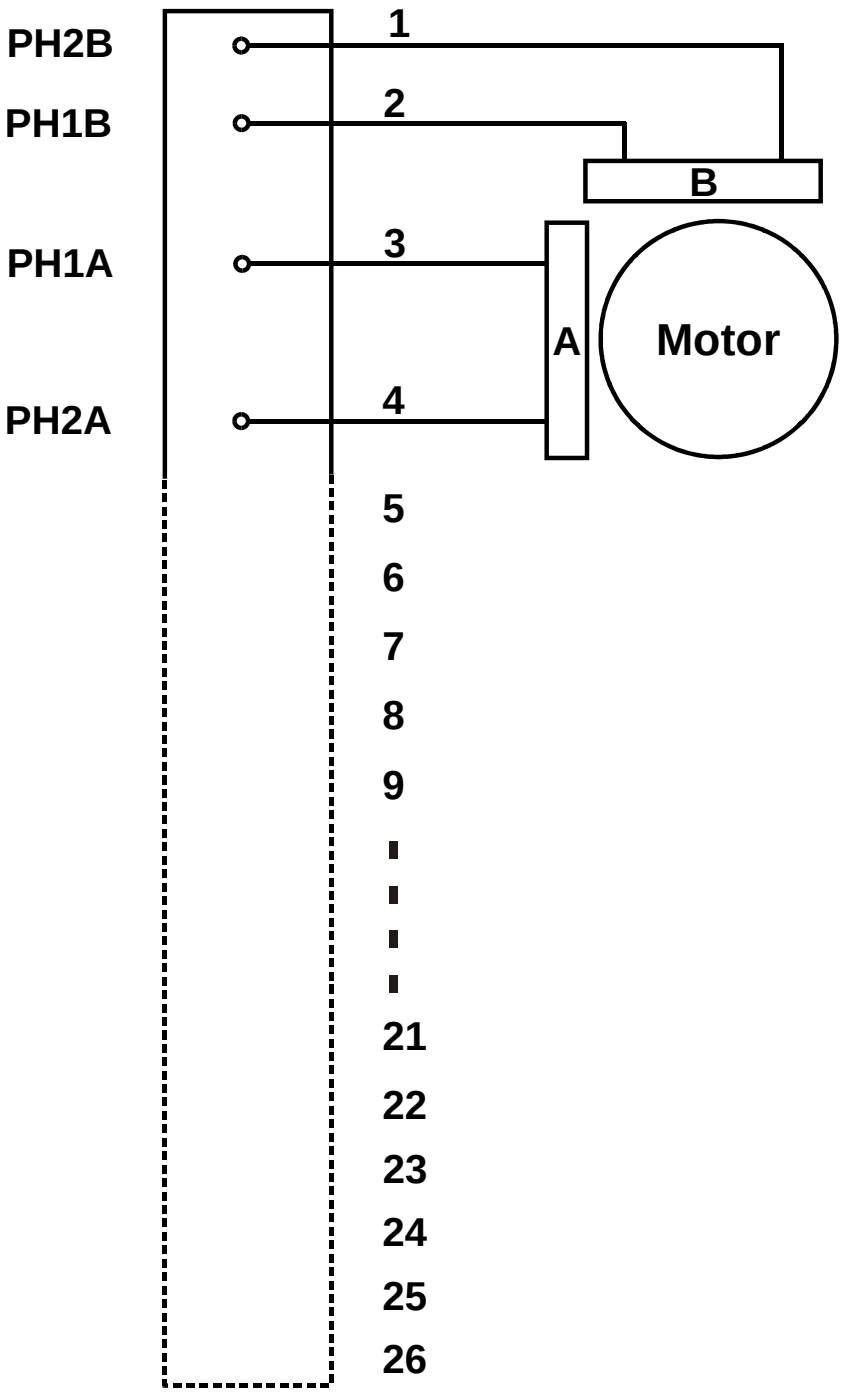
(Tab.1.1)

No.	Signal	Function
1	PH2B	MOTOR
2	PH1B	
3	PH1A	
4	PH2A	
5	Photo-transistor collector	PAPER END SENSOR
6	Led Anode	
7	Photo-transistor emitter/ Led cathode	
8	VH	HEAD POWER SUPPLY
9	VH	HEAD POWER SUPPLY
10	VH	HEAD POWER SUPPLY
11	LAT	LATCH
12	GND	GROUND
13	GND	GROUND
14	GND	GROUND
15	STB1	STROBE1 SIGNAL
16	TM	THERMISTOR
17	V_{DD}	LOGIC VOLTAGE
18	STB2	STROBE2 SIGNAL
19	GND	GROUND
20	GND	GROUND
21	GND	GROUND
22	CLK	SERIAL CLOCK
23	DI	DATA INPUT
24	VH	HEAD POWER SUPPLY
25	VH	HEAD POWER SUPPLY
26	VH	HEAD POWER SUPPLY

Note : The thermistore of print head is connected to V_{DD} on the capton.

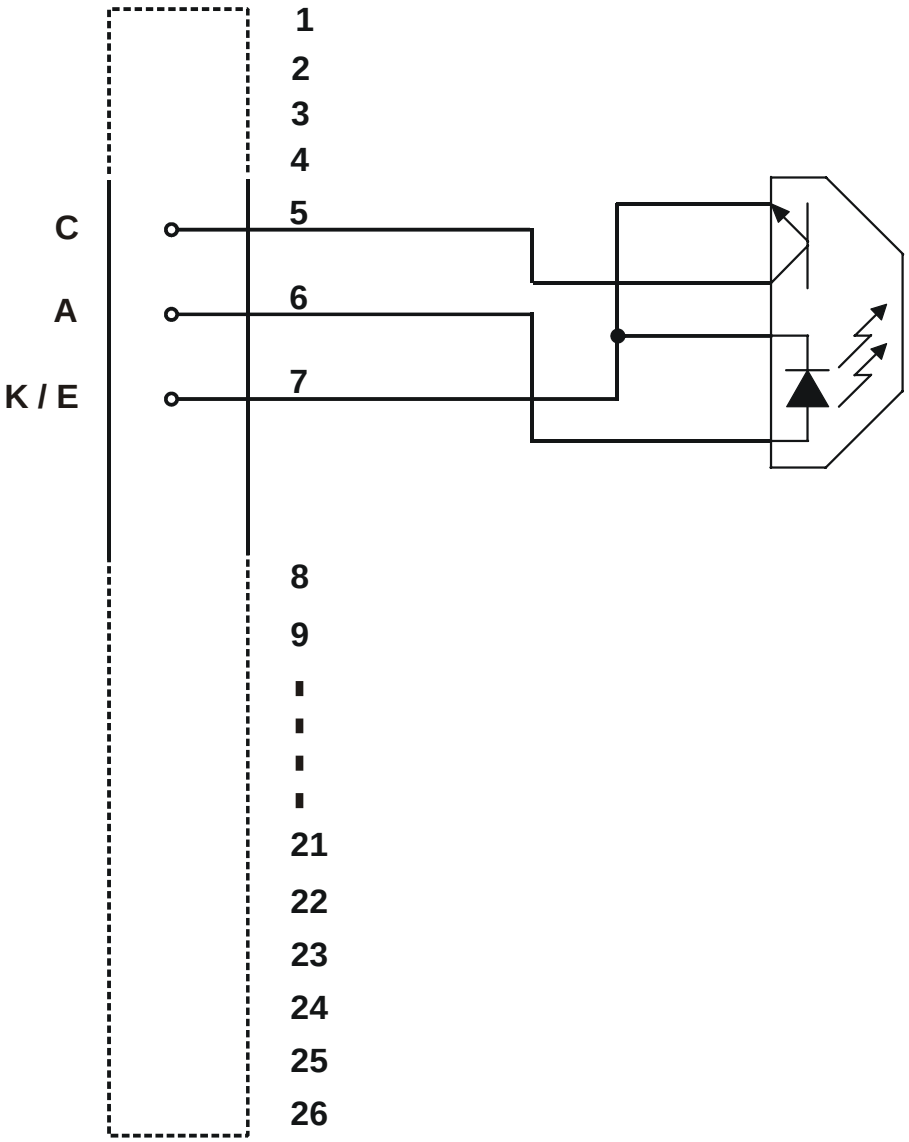
1.2 Electrical circuit block diagram of motor

(Fig.1.2)



1.3 Electrical circuit block diagram of Paper-end sensor

(Fig.1.3)



2.1 PRINT HEAD

MT002 has a thickfilm thermal printhead and is allowed to have 4.0 A maximum power absorbed, the print density variation may become larger if the number of dots energized at same time becomes greater than 64.
Scanning Line Time (SLT) is the time to print one complete line using all strobes available.
The relation between the printhead supply voltage and "On Time" (Ton) is as follows:

$$Po = Io^2 \times Rav = \frac{VH^2 \times Rave}{(Rcom \times N + Rave + Ric + Ric)^2}$$

$$Ton = \frac{Eo}{Po}$$

or

$$Po = \frac{Eo}{Ton}$$

$$VH = \sqrt{\frac{Po}{Rav}} \times (Rcom \times N + Rav + Ric)$$

(Tab.2.1)

Symbol	Parameter	Value	Unit
Rav	Average resistance (Heater resistance + Lead resistance)	176	Ω
N	No. of burning dots at same time	(example 100)	dots
Rcom	Common Resistance	0.05	Ω
Ric	Driver saturated resistance	9	Ω

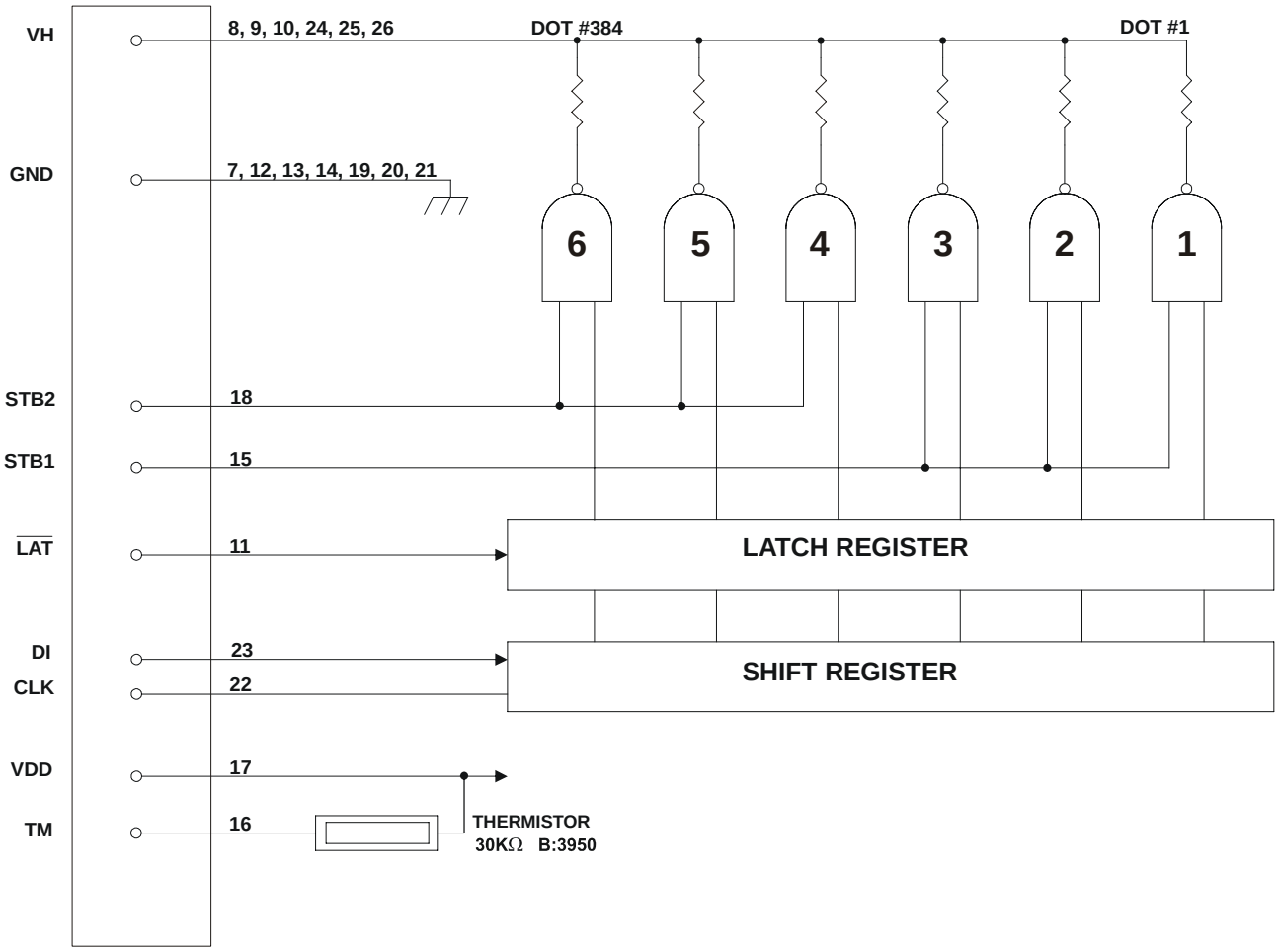
2.2 OPERATION PRECAUTIONS

1. When continuous printing is performed the supply energy should be reduced so that the substrate temperature show in Maximum Condition Table
2. Power On and Off sequence must be in the following order to prevent the dot element damage:
   Turn On= Apply the logic supply voltage (Vdd) first and then the printhead supply voltage (VH).
   Turn Off= Switch off the printhead supply voltage (VH) first and then turn the logic voltage (Vdd) off.
3. The printhead shall be disabled in STB during Power ON/OFF, or Power (VH)-Logic(Vdd) sequence described in note 2 shall be kept.
4. Heat elements and IC's shall be anti-electrostatic in order to prevent the electrostatic destruction. Do not touch the connector pins with naked hands.
5. The printhead substrate surface is coated with glass and mechanical stress or shock (including dust scratch damage) should be avoided to prevent damage.
6. When the printhead operation is finished, printsupply voltage (including the charged voltage with capacitor) should be reduced to the ground level and remained until next printhead operation occur.
7. Condensation should be avoided. If condensation occurred, do not switch on the printhead power until condensation disappear.
8. Print quality would be degraded if paper or ink residue were sticked on the heat element area. For such a case, please use applicator with alcohol to clean up. Do not use the sandpaper destroying the heat elements.

9. If printing sound, for example sticking sound, occured, please review and adjust the paper feed mechanism and the electrical pulse to avoid these kind of mechanical resonance.
10. Please pay attention that the paper used does not include bad factor to affect printhead life.
11. The print density variation may become larger if the number of dots energized at same time becomes greater than 100.
12. In order to avoid surge, a 47 μF capacitor is required between VH and GND at controller board side. 0.1 μF ceramic capacitor should be placed between VDD and GND.

2.3 BLOCK DIAGRAM OF THE ELECTRICAL CIRCUIT

(Fig.2.1)



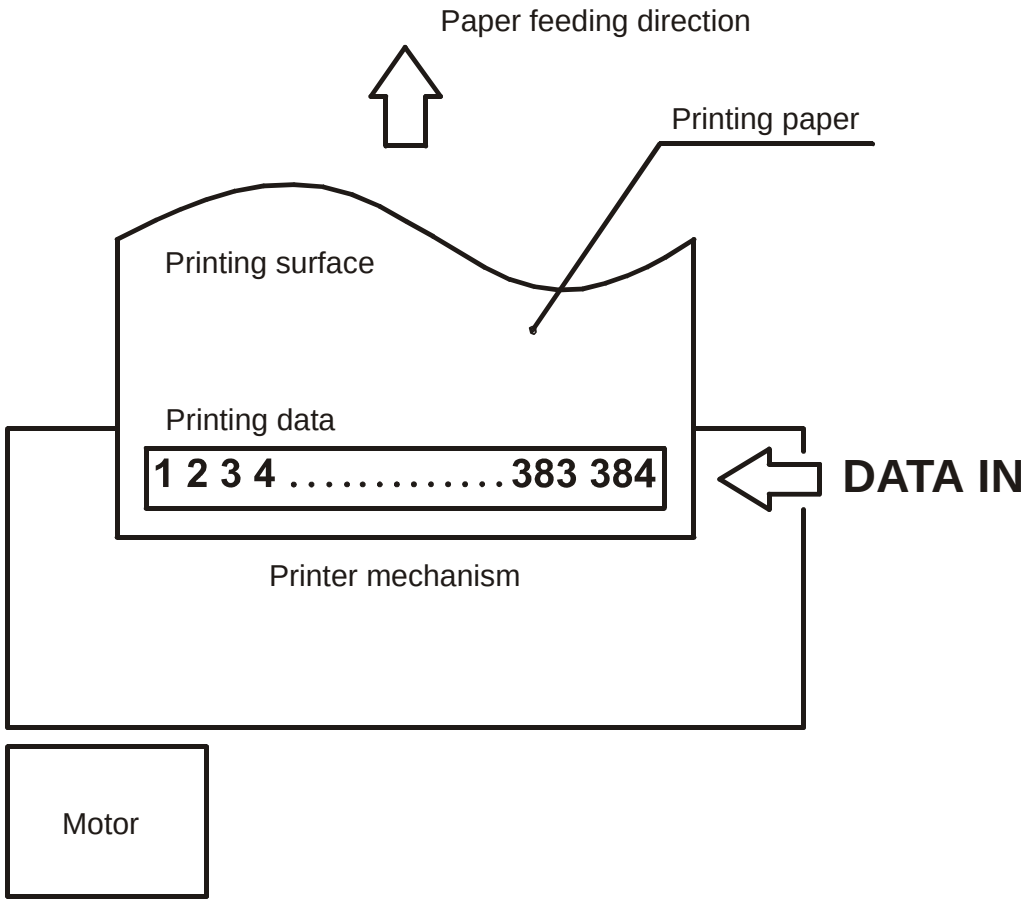
(Tab.2.2)

STB No.	Dot No.	Dots/STB
1	1 ~ 192	192
2	193 ~ 384	192

2.4 PRINTING DATA AND PRINTING POSITION

Print data of 384-bit length is printed in the arrangement as shown in the following figure :

(Fig.2.2)



2.5 ELECTRICAL CHARACTERISTICS OF CIRCUIT

(Tab.2.3)

Item		SYMBOL	MINI	TYP.	MAXI.	Unit	Conditions
Head power supply		V_H	-	7.2	8.5	V	
Logic power supply		V_{DD}	3.00	5.00	5.25	V	
Logic supply current		I_{DD}	-	-	54	mA	fDI = fCLK/2
Input Voltage	High	V_{IH}	0.8 x V_{DD}	-	V_{DD}	V	STB, DI, LAT, CLK
	Low	V_{IL}	0	-	0.2 x V_{DD}	V	
Data input current (DI)	High	I_{IH} DI	-	-	0.5	uA	VIH = 5V VIL = 0V
	Low	I_{IL} DI	-	-	-0.5	uA	
STB input current (STB)	High	I_{IH} STB	-	-	30	uA	
	Low	I_{IL} STB	-	-	-0.5	uA	
Clock input current (CLK)	High	I_{IH} CLK	-	-	3	uA	
	Low	I_{IL} CLK	-	-	-3	uA	
Latch input current (LAT)	High	I_{IH} LAT	-	-	3	uA	
	Low	I_{IL} LAT	-	-	-3	uA	

2.6 SWITCHING CHARACTERISTICS OF CIRCUIT

(Tab.2.4)

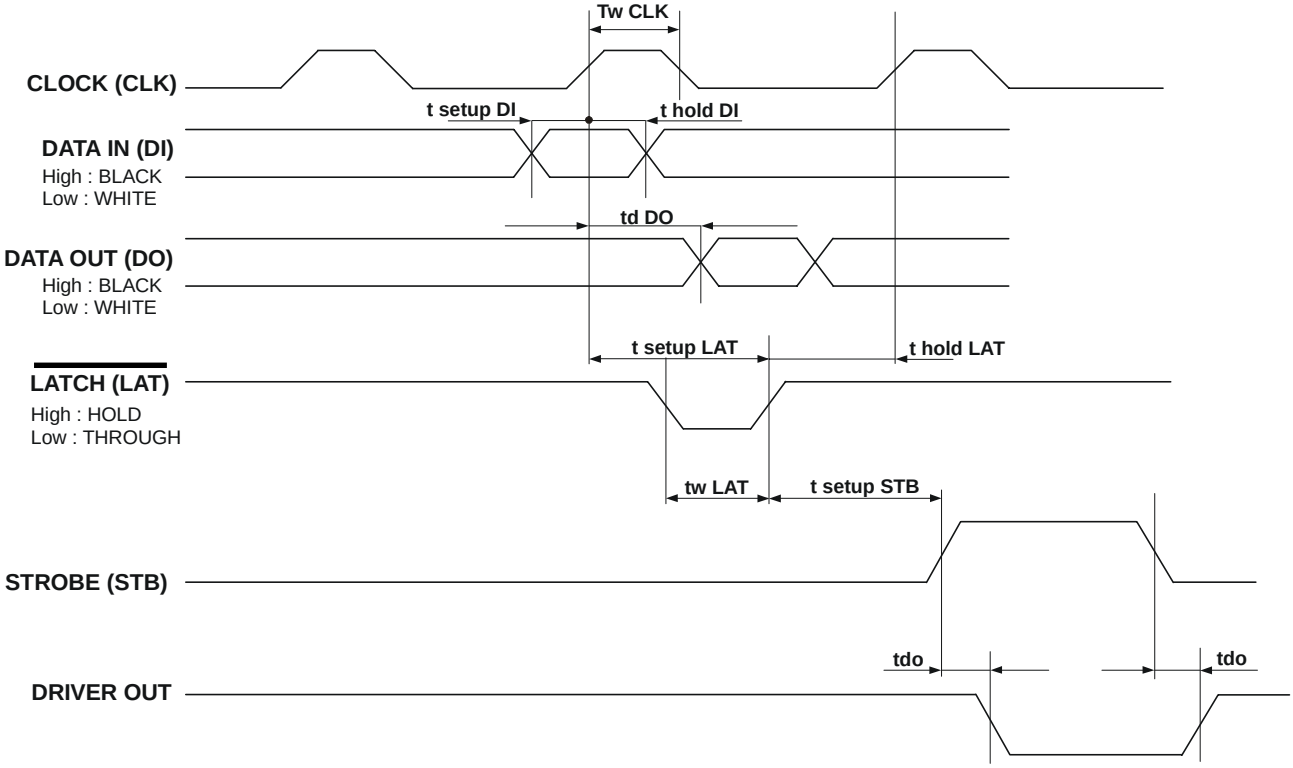
The switching characteristic summarized in the following table :

Item	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Clock frequency	fCLK	-	5	8	MHz	V_{DD}= 5.0V
		-	3	5		V_{DD} = 3.3V
Clock width	tw CLK	95 (155)	-	-	ns	V_{DD}= 5.0V, f_{CLK} = 5MHz
Data set-up time	t setup DI	100 (140)	-	-	ns	V_{DD}= 3.3V, f_{CLK} = 3MHz
Data hold time	t hold DI	85	-	-	ns	
Data out delay time	td DO	-	50	-	ns	V_{DD}= 5.0V
		-	90	-		V_{DD} = 3.3V
Latch width	tw LAT	150	-	-	ns	
Latch set-up time	t setup LAT	200	-	-	ns	
Latch Hold time	t hold LAT	80	-	-	ns	
STB set-up time	t setup STB	300	-	-	ns	
Driver out delay time	tdo	-	-	10 (30)	μs	V_{DD}= 5.0V (V_{DD}= 3.3V)

Notes : CLK should be used at duty 50% (±5%), if operated more than fCLK = 5MHz (or fCLK = 3MHz when VDD = 3.3 V). Also, CLK should be within one cycle , being subject to the ratio between DATA SET-UP TIME and DATA HOLD TIME is 1:1.

2.7 TIMING CHART

(Fig.2.3)



Notes : ***Symbol " ——— " :*** *means a negative logic signal.*

2.8 THERMISTOR

The thermistor is very important to adjust the strobe time (Tstrobe) ~ (SLT) in function of the head temperature and to monitor the temperature to prevent the head damage if the temperature is over the limit described in the Maximum conditions table.

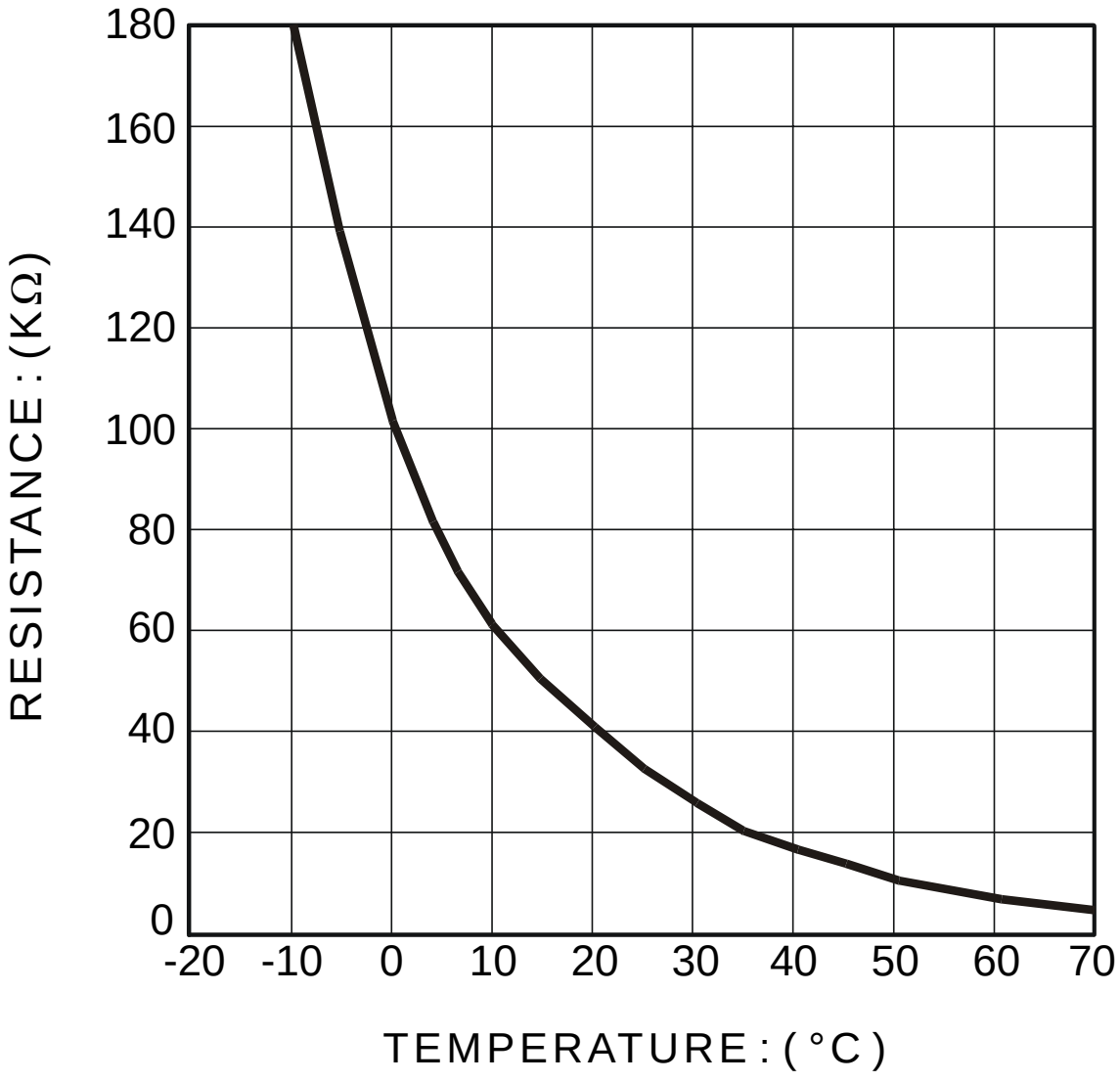
- Resistance R25 : 30 KW ± 5% at 25°C
- B value : 3950 K ± 2%
- Operating temperature : –20 ~ + 80°C
- Time costant : Max. 30 sec.(in the air)

Then the resistance value, R, versus temperature , T (in °C) is given by the formula :

$$R(T) = R25 * e \{B*(1/TX – 1/T25)\}$$

2.8.1 Thermistore Curves

(Fig.2.4)



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3.1 STEPPER MOTOR

The paper feed pitch for stepper motor is 2 steps for one dotline(1).

(1) ***Note:*** *1 dotline = 0.125 mm.*

3.1.1 Technical specifications

Item	Specification
Drive voltage	DC 5.5 V
No. of phases	2
Drive mode	Bipolar drive
Step angle	18° ± 2°
Rated current	350 mA / Phase
Resistance	12Ω ± 7% at 25 °C (each phase)
Inductance	3.7 mH ± 25% at 25°C (1kHz. 1Vrms)
Holding torque	33.7 gf-cm MIN
Pull-out torque (1200 pps)	13.3 gf-cm MIN
Insulation resistance	100 MΩ MIN (500 Vdc)
Insulation class	Class E
Dielectric strength	AC 500V 1 min.
Life	3000 Hr min.
Maximum coil temperature	115°C

(Tab.3.1)

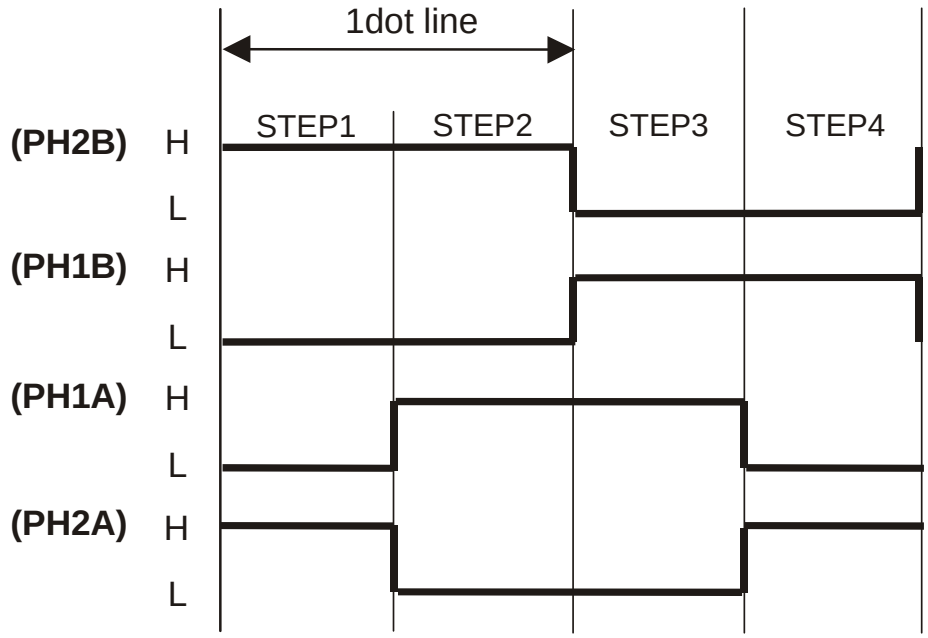
3.1.2 Excitation sequence

The motor is driven in the forward direction if its excitation phases are switched as per the following steps :

Sequence	Signal			
	PH2B	PH1B	PH1A	PH2A
Step1	High	Low	Low	High
Step2	High	Low	High	Low
Step3	Low	High	High	Low
Step4	Low	High	Low	High

(Tab.3.2)

Excitation Voltage Waveforms



(Fig.3.1)

3.2 PRECAUTION

1. Drive the motor with mosfet driver to obtain the maximum torque force instead transistor driver , transistor driver lose voltage VCEsat *2.

2. Please check the ratio print/pause to prevent the overtemperature on stepper motor.

3. If the motor is driven by more than 5 volts we suggest to use a chopper driving, in order to reduce current, please contact CUSTOM ENGINEERING SPA for further information.

4.1 SENSOR

Maximum Ratings (Ta = 25°C) **(Tab.4.1)**

Parameter		Symbol	Rating	Unit
Input	Power dissipation	P_D	75	mW
	Reverse voltage	V_R	5	V
	Forward current	I_F	50	mA
	Pulse forward current [1]	I_{FP}	1	A
Output	Collector power dissipation	P_C	50	mW
	Collector current	I_C	20	mA
	Collector-emitter voltage	V_{CEO}	30	V
	Emitter-collector voltage	V_{ECO}	3	V
Operating temperature range		T_{OPR}	-20 ~ 85	°C
Storage temperature range		T_{STG}	-30 ~ 100	°C

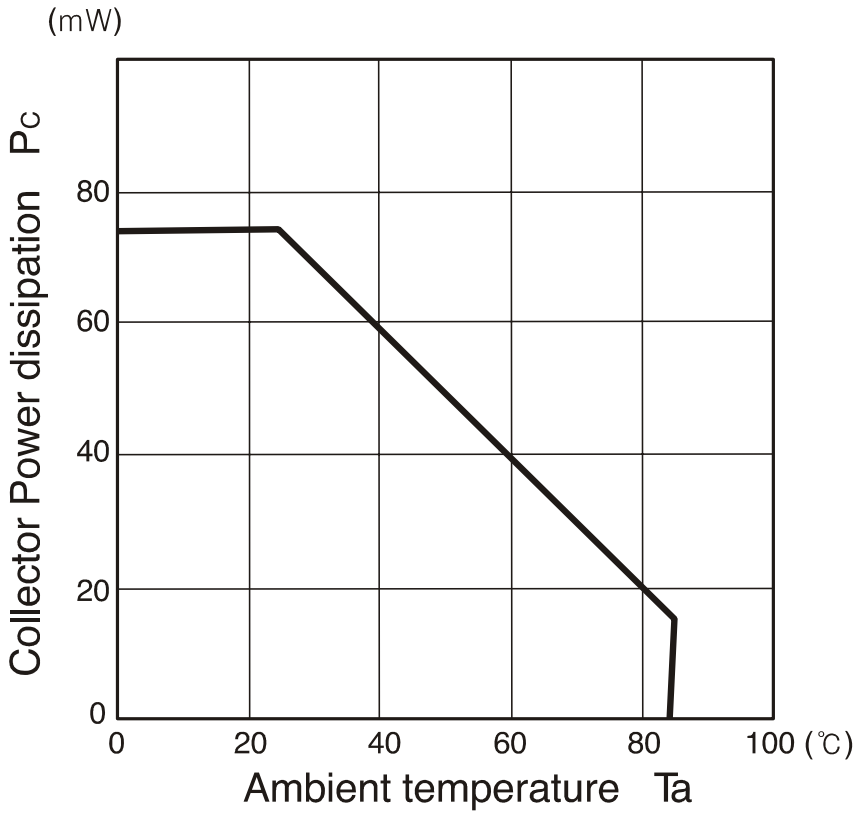
[1] ***NOTE:*** *Pulse width ≤ 100 μs, Repetitive frequency = 100 Hz.*

Opto-electrical characteristics (Ta = 25°C) **(Tab.4.2)**

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F = 10 mA	-	-	1.3	V
	Reverse current	I_R	V_R = 5 V	-	-	10	μA
	Peak emission wavelength	λ_P	I_F = 10 mA	-	940	-	nm
Output	Collector dark current	I_{CEO}	V_{CE} = 10 V	-	-	0.2	μA
	Peak sensibility wavelength	λ_P		-	900	-	nm
Light current		I_L	V_{CE} = 5 V, I_F = 10 mA	90	-	-	μA
Leakage current		I_{LEAK}	V_{CE} = 5 V, I_F = 10 mA	-	-	0.2	μA
Switching speeds	Rise time	t_r	V_{CC} = 2 V, I_C = 0.1 mA, R_L = 1 KΩ	-	30	-	μs
	Fall time	t_f		-	25	-	μs

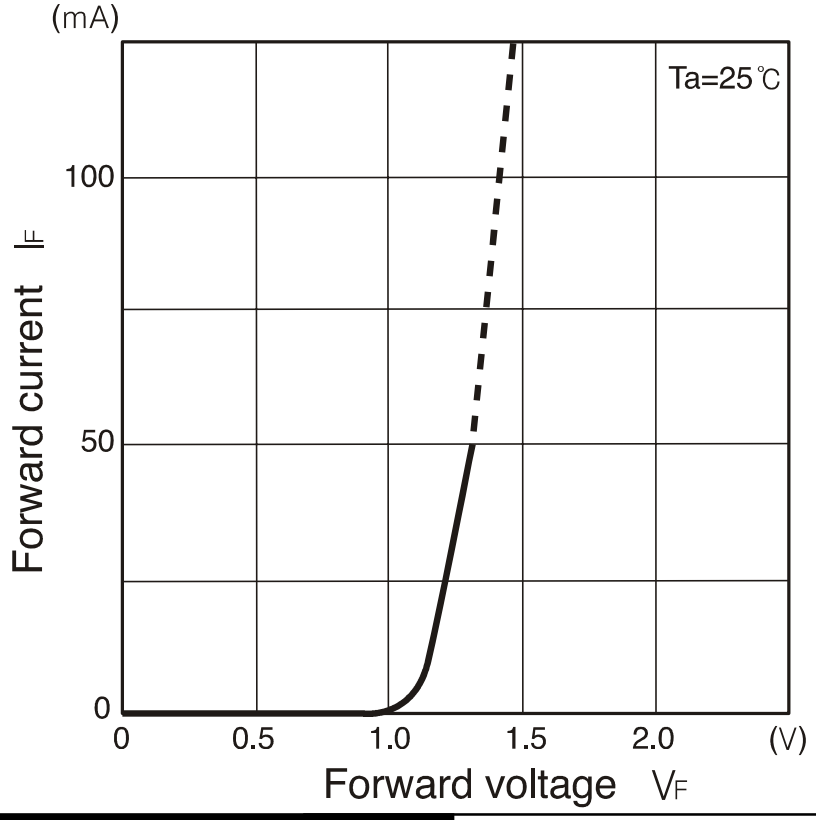
4.2 GRAPHICS OF TYPICAL CHARACTERISTICS

Collector Power dissipation vs. Ambient Temperature



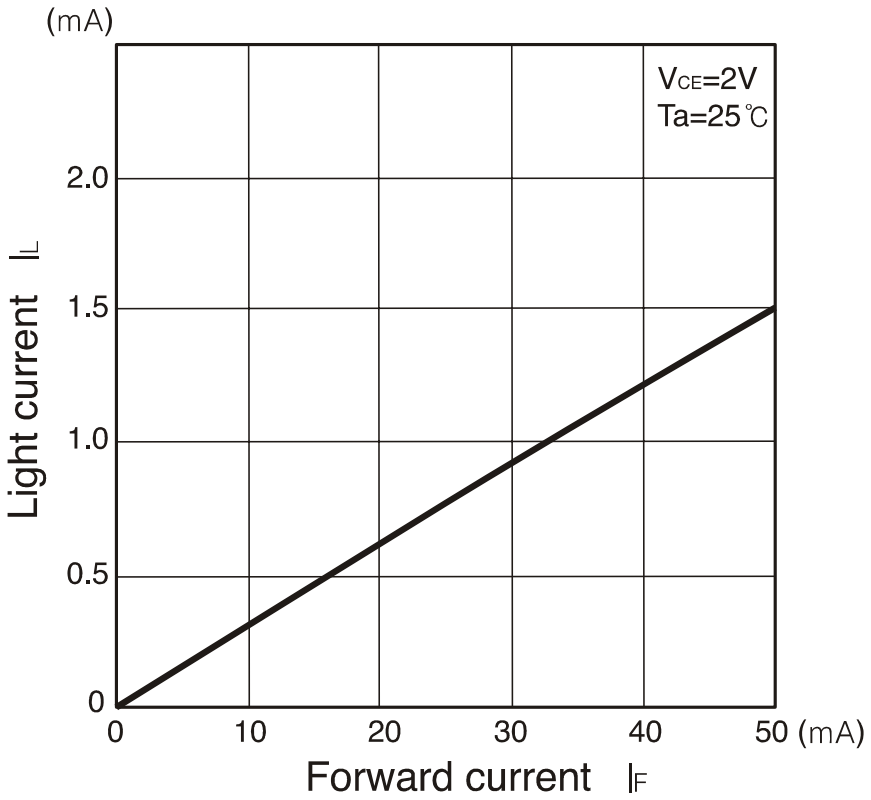
(Fig.4.1)

Forward Current vs. Forward Voltage



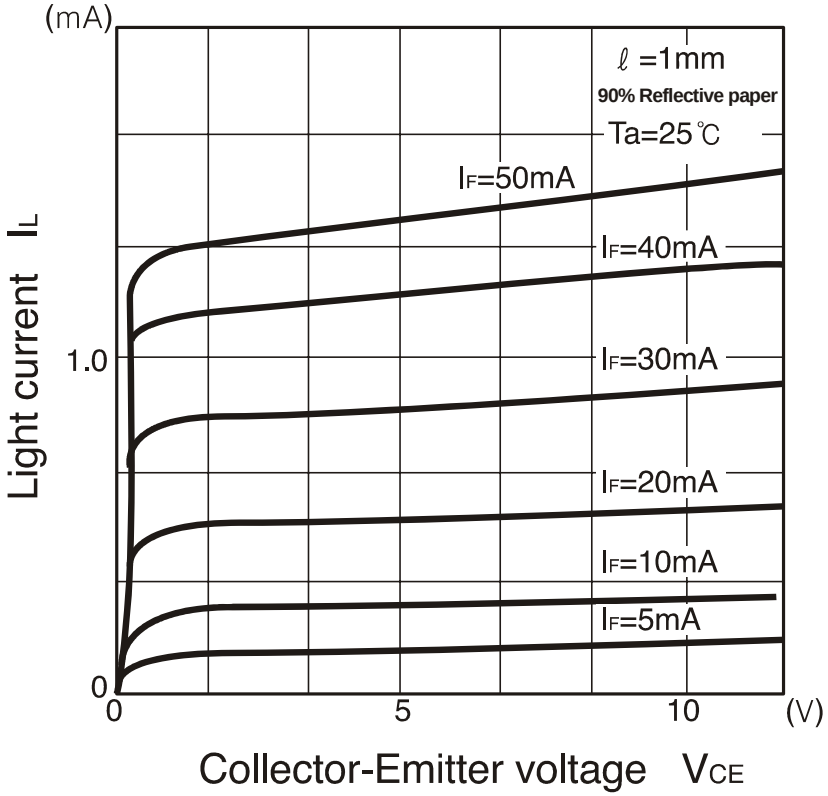
(Fig.4.2)

Light Current vs. Forward Current



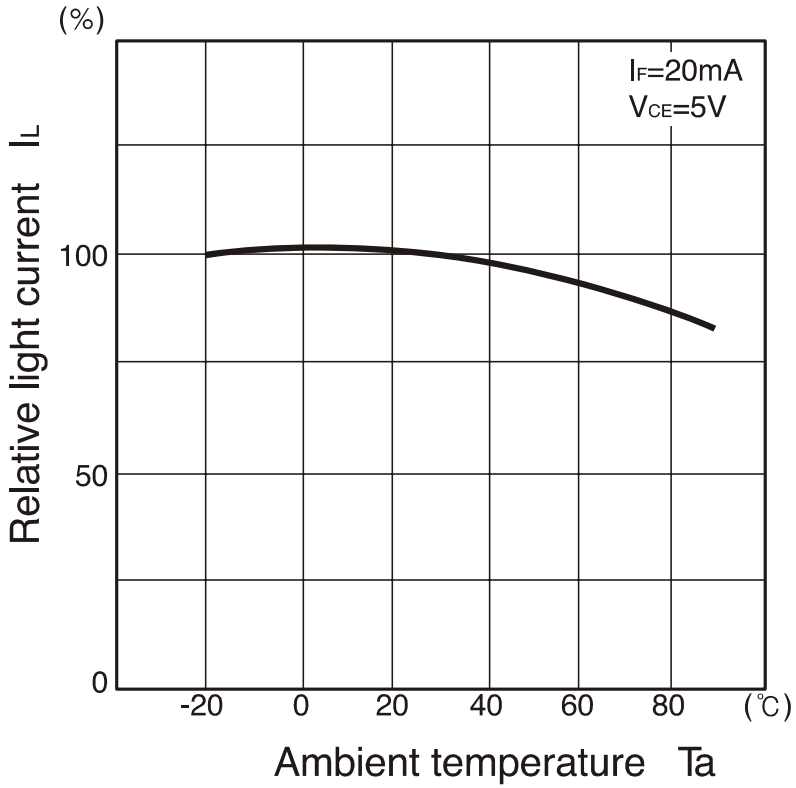
(Fig.4.3)

Light Current vs. Collector-Emitter Voltage



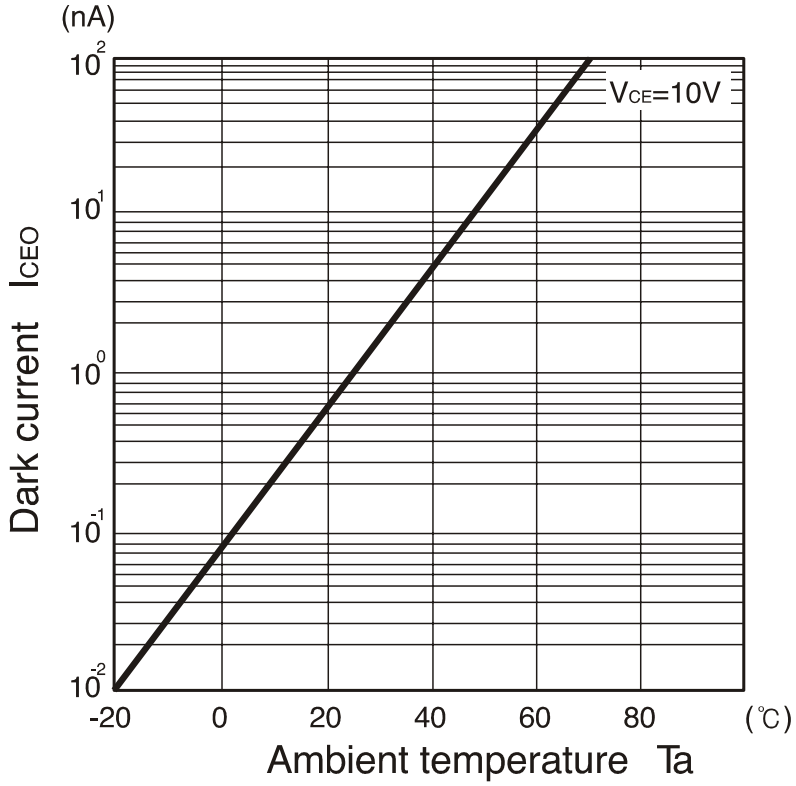
(Fig.4.4)

Relative light current vs Ambient temperature



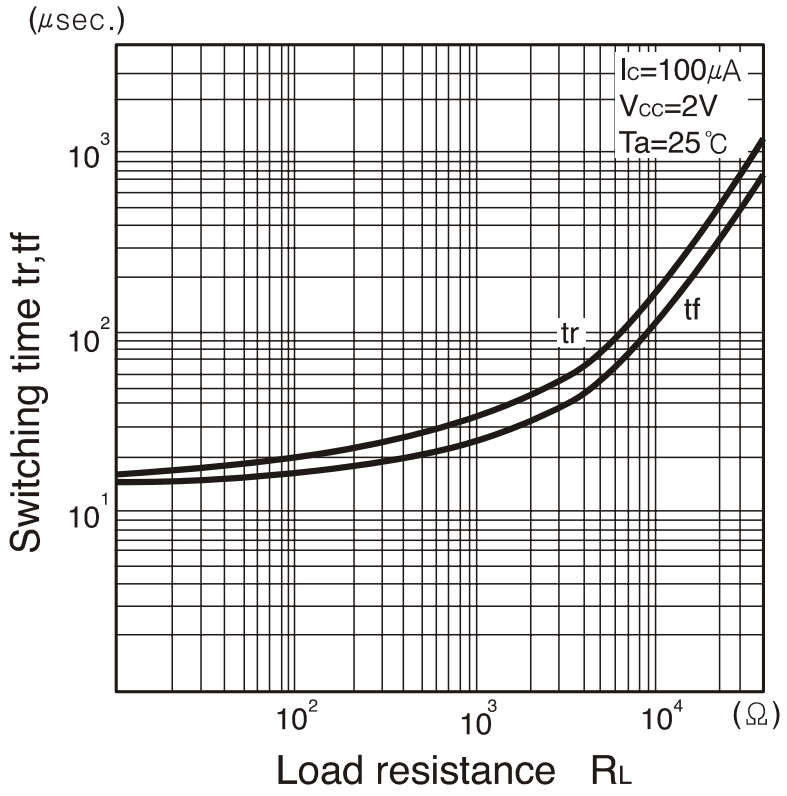
(Fig.4.5)

Dark current vs Ambient temperature



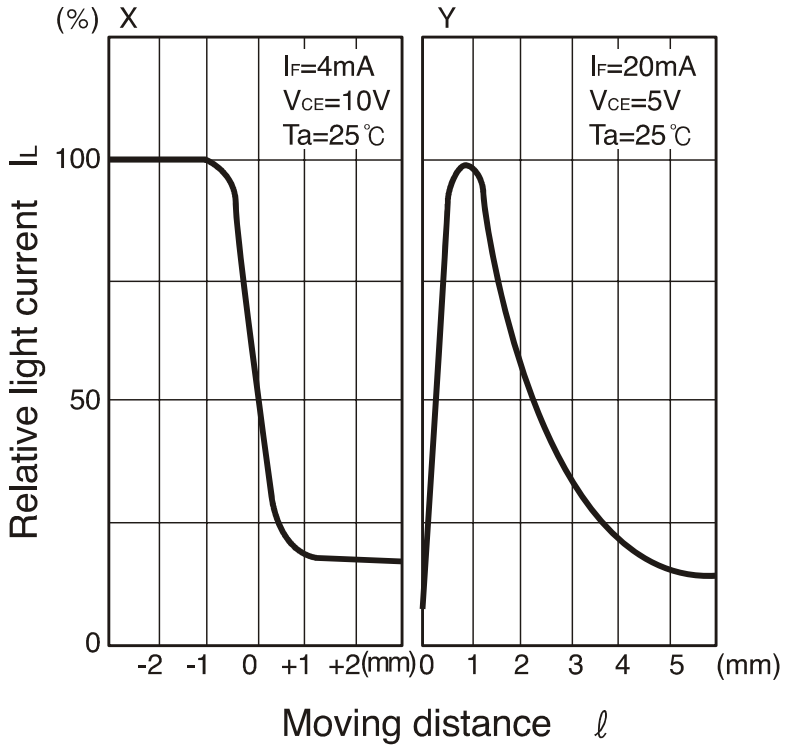
(Fig.4.6)

Switching time vs Load resistance



(Fig.4.7)

Relative light current vs Moving distance



(Fig.4.8)

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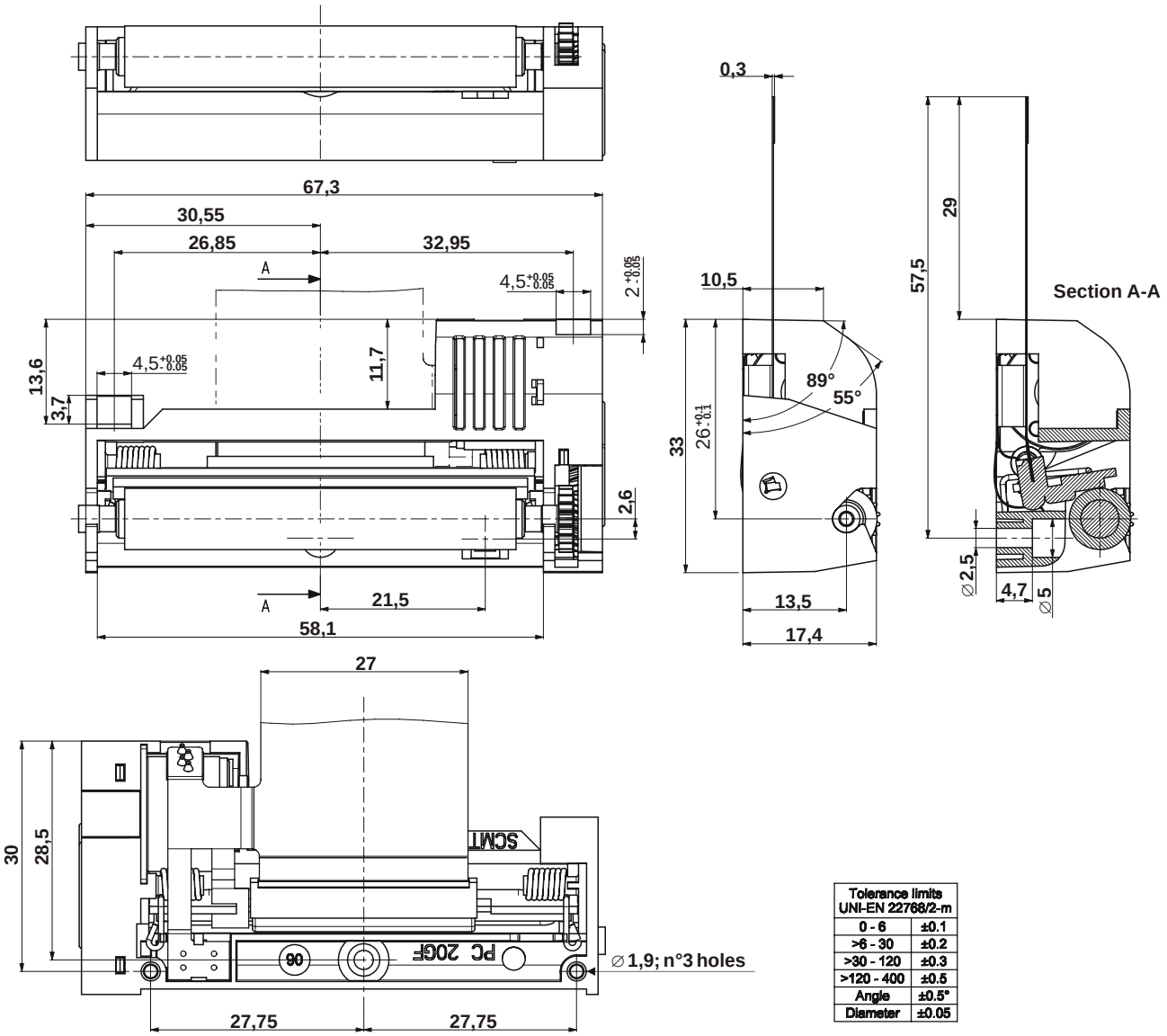
5. DIMENSIONS

5.1 DIMENSIONS OF MT001 MODEL

The figure 5.1 illustrates the overall dimensions for the MT002 thermal printing mechanism.

(Dimensions in mm)

(Fig.5.1)



Tolerance limits UNI-EN 22768/2-m	
0 - 6	±0.1
>6 - 30	±0.2
>30 - 120	±0.3
>120 - 400	±0.5
Angle	±0.5°
Diameter	±0.05

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